TOTAL MAXIMUM DAILY LOAD (TMDL)

For
Dissolved Oxygen, BOD and Nutrients
In
Bessey Creek
(WBID 3211)

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LIST OF ABBREVIATIONS

AWT	Advanced Waste Treatment
BMP	Best Management Practices
BPJ	Best Professional Judgment
CFS	Cubic Feet per Second
DEM	Digital Elevation Model
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
F.A.C.	Florida Administrative Code
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MPN	Most Probable Number
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agriculture Statistics Service
NLCD	National Land Cover Data
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OSTD	Onsite Sewer Treatment and Disposal Systems
PLRG	Pollutant Load Reduction Goal
Rf3	Reach File 3
RM	River Mile
STORET	STORage RETrieval database
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WBID	Water Body Identification
WLA	Waste Load Allocation
WMP	Water Management Plan
WWTF	Wastewater Treatment Facility

SUMMARY SHEET

Total Maximum Daily Load (TMDL)

1. **303(d) Listed Waterbody Information**
   State: Florida
   Major River Basin: St. Lucie

Impaired Waterbodies for TMDLs (1998 303(d) List):

WBID	Segment Name and Type	River Basin	County	Constituent(s)
3211	Bessey Creek	Southeast Coast	St. Lucie	Dissolved Oxygen, BOD Nutrients

2. **TMDL Endpoints (i.e., Targets)**

The State of Florida has narrative criteria for nutrients stating that in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna. Biochemical Oxygen Demand (BOD) shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each class and, in no case, shall it be great enough to produce nuisance conditions.

TMDLs for BOD, and low DO were addressed by analyzing the effects of BOD loads on dissolved oxygen concentrations. BOD loads were calculated using a Nonpoint Source spreadsheet model. The target for DO is based on the State of Florida's water quality criteria for D.O., which requires that in no case should the concentration of dissolved oxygen be less than 5 mg/L in freshwater streams. TMDLs for nutrients (TN and TP) are based on meeting the St. Lucie River and Estuary nutrient TMDL requiring a 35 percent reduction in TN and TP. Current point and nonpoint source loads of BOD, TN and TP were estimated using the Nonpoint Source spreadsheet model.

3. **Nutrient Allocation:**

Stream Name / WBID	Parameter	WLA	LA	TMDL
		MS4		
Bessey Creek (3211)	BOD	66% reduction	66% reduction	66% reduction
Bessey Creek (3211)	TN	43% reduction	43% reduction	43% reduction
Bessey Creek (3211)	TP	43% reduction	43% reduction	43% reduction

4. **Endangered Species (yes or blank): Yes**

5. **EPA Lead on TMDL (EPA or blank): EPA**

6. **TMDL Considers Point Source, Nonpoint Source, or both: Both**

7. NPDES Discharges to surface waters addressed in TMDLs:

Facility Name	NPDES No.	Facility Type	Receiving Stream
Martin County Utilities (MCU) Consolidated Reuse System (South County) in Port Salerno	FL0043214	Municipal Reuse System	Roebuck Creek and Bessey Creek
Martin County MS4	FLR04E013	MS4	many
City of Stuart MS4	FLR04E031	MS4	many
Sewall's Point MS4	FLR04E044	MS4	many

TOTAL MAXIMUM DAILY LOAD (TMDL) NUTRIENTS AND DISSOLVED OXYGEN IN BESSEY CREEK WATER BODY ID

1. INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

The State of Florida Department of Environmental Protection (FDEP) developed a statewide, watershed-based approach to water resource management. Under the watershed management approach, water resources are managed on the basis of natural boundaries, such as river basins, rather than political boundaries. The watershed management approach is the framework DEP uses for implementing TMDLs. The state's 52 basins are divided into 5 groups. Water quality is assessed in each group on a rotating five-year cycle. The Group 2 basin is shown in Figure 1 and includes the St. Lucie and Loxahatchee River Basins. The St. Lucie and Loxahatchee Basins encompass many square miles. To provide a smaller-scale geographic basis for assessing, reporting, and documenting water quality improvement projects, the FDEP subdivided the Group 2 area into smaller areas called planning units. Planning units help organize information and management strategies around prominent subbasin characteristics and drainage features. To the extent possible, planning units were chosen to reflect subbasins that had previously been defined by the South Florida Water Management District (SFWMD). The St. Lucie and Loxahatchee Basins contain eight planning units: C-25/Basin 1, North St. Lucie, C-24, C-23, South St. Lucie, C-44, Loxahatchee, and Coastal. Water quality assessments were conducted on individual waterbody segments within planning units. Each waterbody segment is assigned a unique waterbody identification (WBID) number. Waterbody segments are the assessment units or polygons that have historically been used by the FDEP to define waterbodies in their biannual inventory and reporting of water quality to EPA under Section 305(b) of the federal Clean Water Act. The same WBIDs are also the assessment units identified in the FDEP's biannual lists of impaired waters submitted to EPA as part of their reporting under Section 303(d) of the Clean Water Act.

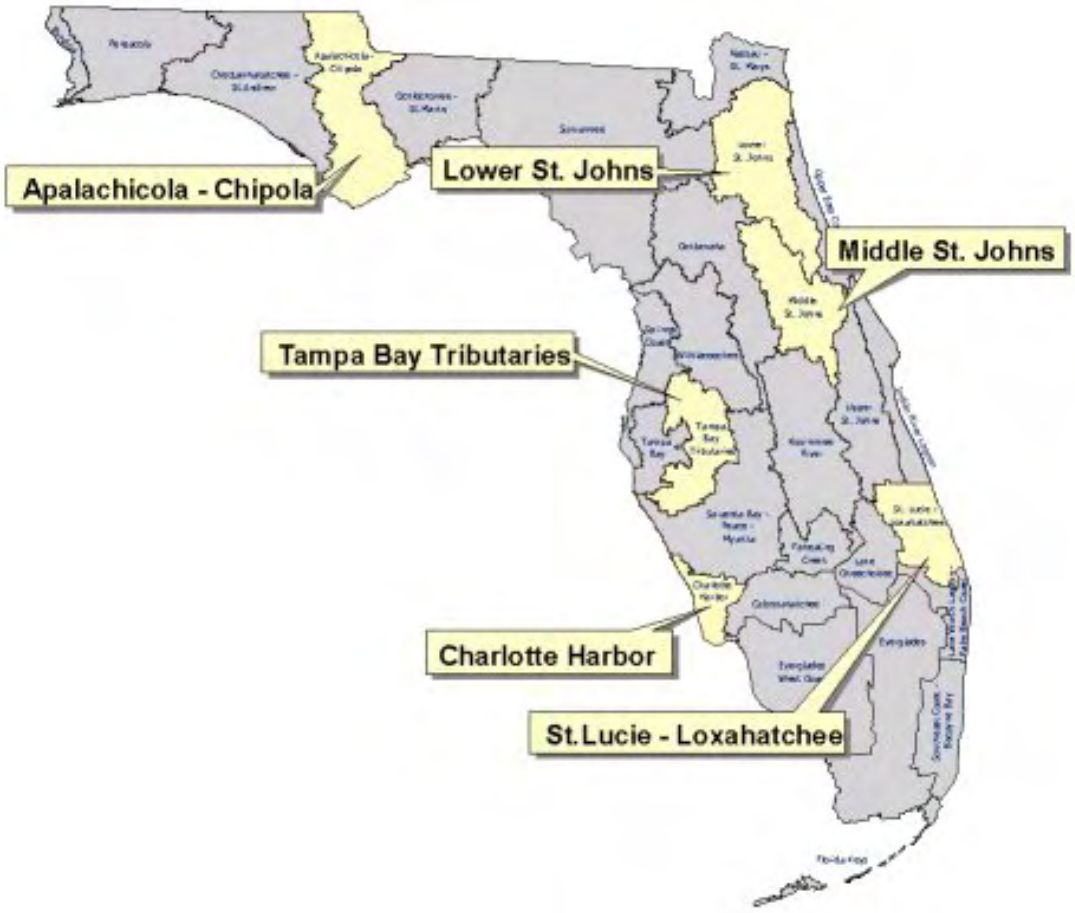


Figure 1: FDEP Group 2 River Basins

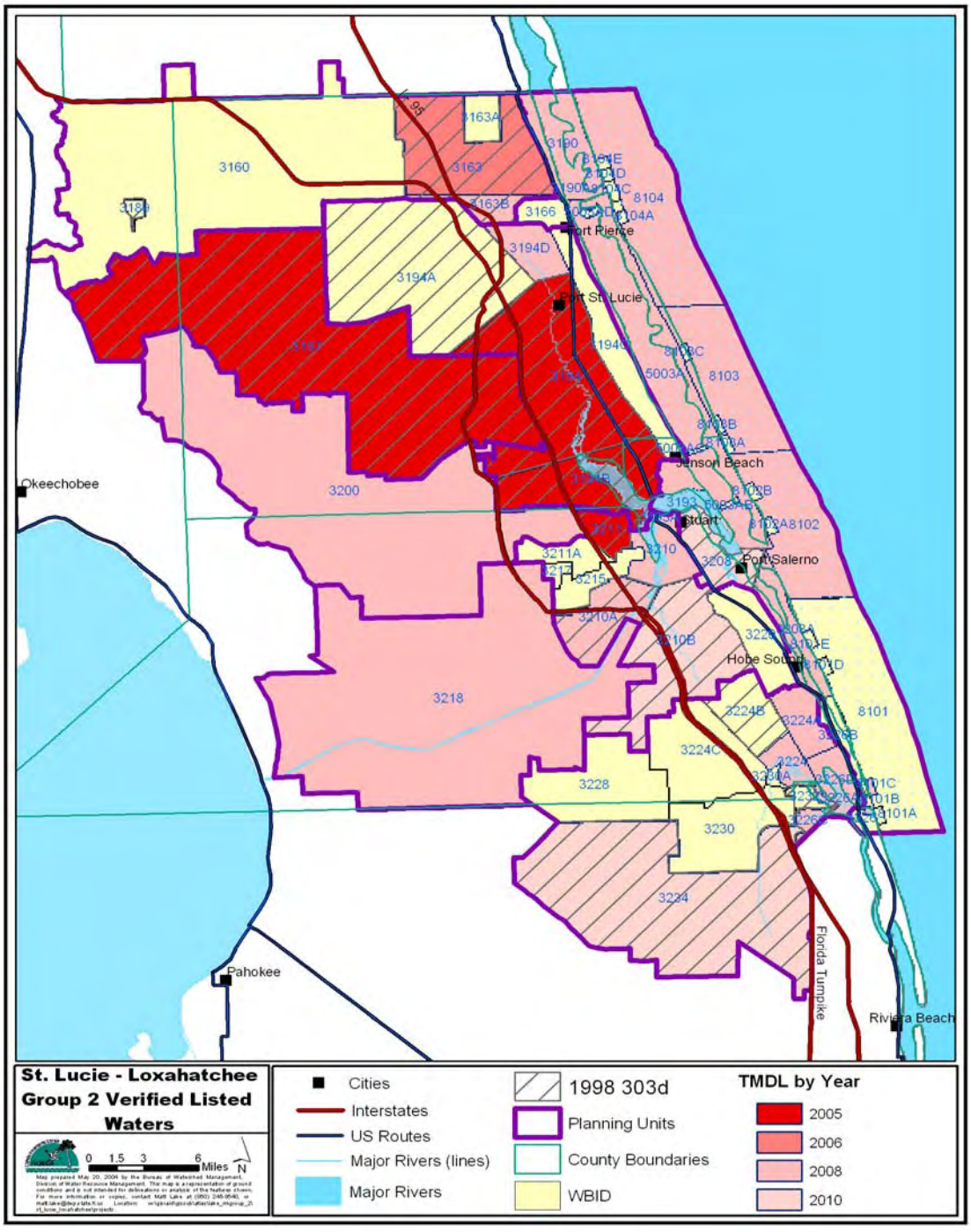


Figure 2: St. Lucie / Loxahatchee River Basin. WBID 3211 is on the 1998 303(d) list for Dissolved Oxygen, BOD and Nutrients.

2. PROBLEM DEFINITION

Florida's final 1998 Section 303(d) list identified WBID 3211 in the St. Lucie River Basin as not supporting water quality standards (WQS) due to dissolved oxygen and nutrients. After assessing all readily available water quality data, EPA is responsible for developing dissolved oxygen, BOD and nutrients TMDLs in WBID 3211, Bessey Creek. The location of WBID 3211 is shown in Figure 2. The TMDL addressed in this document is being proposed pursuant to EPA commitments in the 1998 Consent Decree in the Florida TMDL lawsuit (Florida Wildlife Federation, et al. v. Carol Browner, et al., Civil Action No. 4: 98CV356-WS, 1998).

WBID 3211 is designated as a Class III water. The designated use of Class III waters is recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Class III waters are further categorized based on fresh or marine waters.

3. WATERSHED DESCRIPTION

The following information is from the FDEP, 2003, Basin Status Report for St. Lucie and Loxahatchee. In the St. Lucie Basin, most of the land in the non-coastal areas is used for the production of citrus and beef cattle. The extensive network of canals that drains these agricultural areas transports storm-water runoff containing nutrients, sediment, bacteria, and other pollutants. These reach the natural drainage-ways (such as the North and South Forks of the St. Lucie River) and ultimately the St. Lucie Estuary and the South Indian River Lagoon. The St. Lucie Canal (C-44), the inland waterway that connects Lake Okeechobee to Florida's east coast, transports regulated releases of water from Lake Okeechobee and runoff from agricultural areas within the C-44 basin. Other major canals also transport storm-water from inland agricultural areas to the estuary. Canals C-23 and C-24 discharge water into the North Fork of the St. Lucie River and the C-25 Canal discharges to the Indian River Lagoon. These canals transport loads of nutrients and eroded sediment to the estuary and slugs of fresh water that create fluctuations in estuarine salinity levels. Urban and residential areas continue to expand in the coastal areas, with polluted urban storm-water runoff and seepage from septic tanks also contributing to the water quality problems in streams and canals. As a result, parts of the St. Lucie Estuary (SLE) appear to be impaired by nutrients, copper, and low levels of DO. Nutrient loads, salinity fluctuations, and accumulations of sediment stress the estuarine ecology. Other evidence of impairment was gathered for the SLE segments in a FDEP South East District biological survey (Graves et al., June 2002). Sediment accumulation, decline of sea-grasses and oysters, algal blooms, fish kills, and low diversity of benthic macroinvertebrates in the SLE comprise this body of evidence.

WBID 3211 is in the South St. Lucie planning unit of the St. Lucie Basin. The South St. Lucie planning unit lies in Martin County and includes most of the city of Stuart (in the southeastern part), plus portions of Palm City, Coral Gardens, Gomez, and Hobe Sound. This planning unit includes the natural drainage of the South St. Lucie River and includes several SFWMD subbasins. These include the Tidal St. Lucie subbasin, which includes the South Fork of the SLE, Manatee Creek Basin, Bessey Creek drainage, and Danforth Creek. It also includes the eastern terminus of canal C-44 (St.

Lucie Canal) through which flow is regulated by the S-80 structure. Bessey Creek (3211) is a tributary to the SLE. This segment of Bessey Creek exceeds the Planning List criteria for DO per the IWR and is also on the 1998 303(d) list for coliform, nutrients, BOD, and DO. Recent FDEP monitoring data not included in the preliminary assessment indicate that 3211 is also potentially impaired for nutrients based on chlorophyll-a detections. Another segment of Bessey Creek (3211A) does not have sufficient data to be assessed. There are four freshwater stream segments in the planning unit that were evaluated, South Fork of the St. Lucie River south of the estuary (3210B), Basin 6 (3215), Basin 5 (3217), and Basin 2 (3220). The South Fork segment is potentially impaired, exceeding the Verified List criteria for biology and for DO. It is also on the 1998 303(d) list for a variety of parameters including coliform, nutrients, BOD, and DO. Basins 6, 5, and 2 (3220) do not have sufficient data to be assessed.

Wetlands comprise approximately 10 percent of this planning unit and upland forests cover approximately 25 percent of the area. The South Fork of the St. Lucie River and the Atlantic Ridge (in the southern part of this planning unit) are designated as a Save Our Rivers (SOR) priority natural areas for acquisition. It is through the C-44 Canal discharge into the South Fork of the St. Lucie River that many of the ecological impacts to the SLE have been felt. The massive surges of fresh water have severely stressed the entire ecosystem of the estuary, dramatically reducing the salinity level at times. The sediment load carried by C-44 has blanketed the bottoms of the estuary, the river, and its tributaries and depleted the natural benthic habitat. Urban and agricultural canals that discharge to the estuary are in some respects equally to blame for the decline in the estuary (St. Lucie River Issues Team Report, October 1998).

Under the Feasibility Study, approximately 17,143 acres of pastureland in the Pal-Mar tract will be converted to a Natural Storage and Treatment Area. This area is in both the South St. Lucie (Tidal St. Lucie) and C-44 planning units. By plugging canals that would otherwise discharge directly to C-44 and the South Fork and by taking land out of agricultural land use, this component will improve water quality and reduce the sediment load to the river and estuary. Issues Team plans include three significant urban stormwater retrofit projects underway in the Stuart area. These include the Poppleton Creek, Fern Creek, and Frazier Creek projects that incorporate detention and treatment of urban stormwater before it reaches the St. Lucie River and the estuary. Approximately 25 percent of this planning unit is used for agricultural purposes, primarily in improved pastureland. Like elsewhere, implementation of best management practices (BMPs) to reduce polluted runoff from cow-calf operations are important to the improvement of water quality in the receiving waterbodies.

WBID 3211 is highly developed with 51 percent residential and 18 percent commercial and industrial. The land cover distribution for these and other cover types is shown in Table 1. The WBID includes Bessey Creek and its tributaries from the Bessey Creek mouth at the St. Lucie River extending upstream about 5 kilometers.

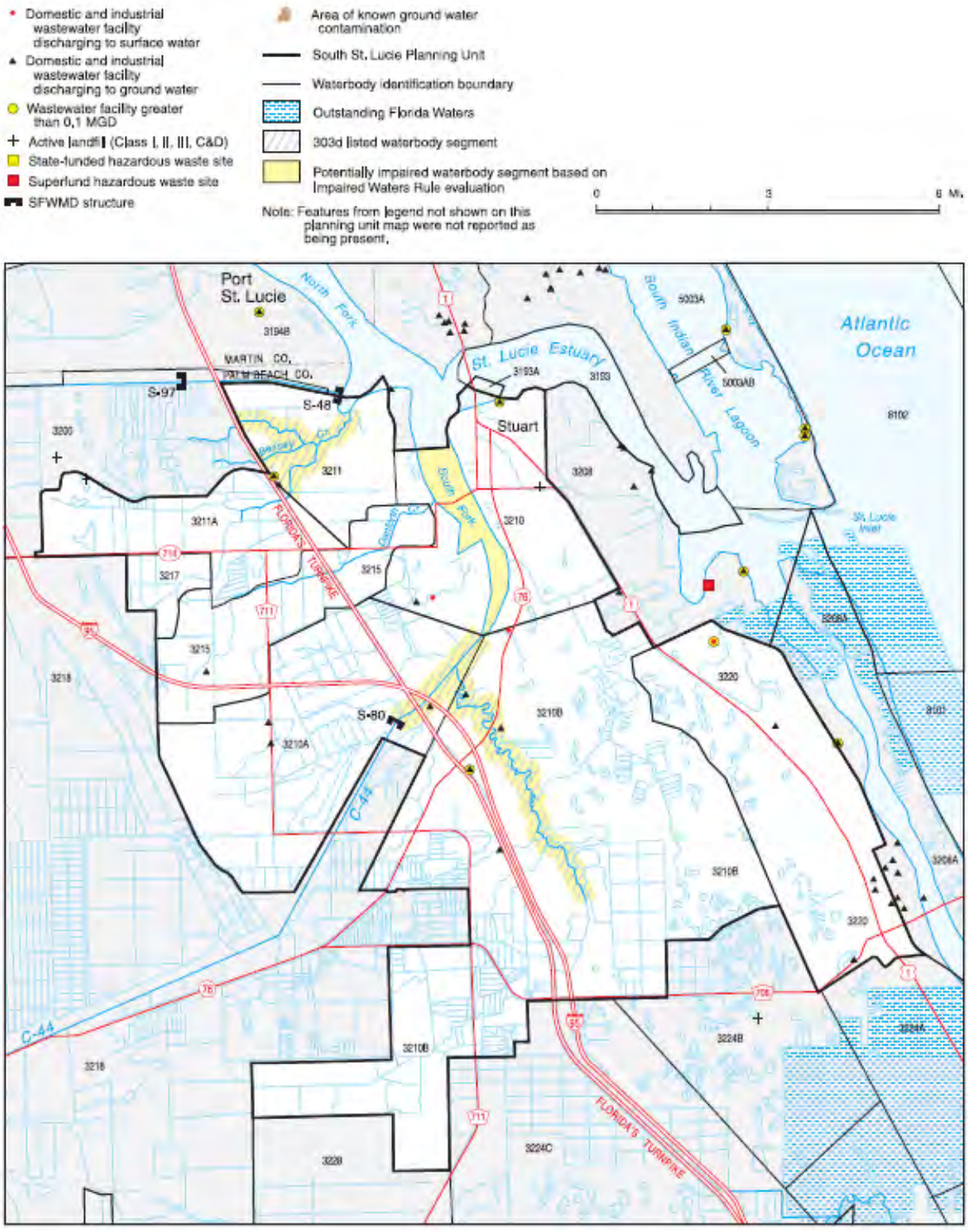


Figure 3: South St. Lucie Planning Unit

Table 1: Land Cover Distribution for WBID 3211 in acres and percentage.

Land Cover	Acreage	Percentage
Residential (1100-1390)	1823	51%
Commercial, Industrial, Public (1400, 1500, 1800)	665	18%
Agriculture (2000 series)	123	3%
Rangeland (3000 series)	46	1%
Forest (4000 series)	326	9%
Water (5000 series)	247	7%
Wetlands (6000 series)	286	8%
Barren & Extractive (7000, 1600)	2	0%
Transportation & Utilities (8000 series)	83	2%
TOTAL (acres)	3599	

4. WATER QUALITY STANDARD FOR DISSOLVED OXYGEN AND NUTRIENTS AND TARGET IDENTIFICATION

Florida's surface waters are protected for five designated use classifications, as follows:

Class I	Potable water supplies
Class II	Shellfish propagation or harvesting
Class III	Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife
Class IV	Agricultural water supplies
Class V	Navigation, utility, and industrial use (there are no state waters currently in this class)

Waterbodies in WBID 3211 are classified as Class III freshwaters, with a designated use of recreation, propagation and maintenance of a healthy, well-balanced population of fish and wildlife. The water quality criteria for protection of Class III waters are established by the State of Florida in the Florida Administrative Code (F.A.C.), Section 62-302.530. The individual criteria should be considered in conjunction with other provisions in water quality standards, including Section 62-302.500 F.A.C. [Surface Waters: Minimum Criteria, General Criteria] that apply to all waters unless alternative criteria are specified in F.A.C. Section 62-302.530. In addition, unless otherwise stated, all criteria express the maximum not to be exceeded at any time. While the State of Florida does not have numeric criteria for nutrients, a narrative criterion exists as described below. The specific criteria that apply to WBID 3211 are:

4.1 Nutrients

The discharge of nutrients shall continue to be limited as needed to prevent violations of other standards contained in this chapter [Section 62.302 F.A.C.]. In no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora and

fauna [Section 62.302.530 F.A.C.]

Because the State of Florida does not have numeric criteria for nutrients, chlorophyll and D.O. levels are used to indicate whether nutrients are present in excessive amounts.

4.2 Dissolved Oxygen

Freshwater: Dissolved Oxygen (D.O.) shall not be less than 5.0 (milligrams/liter). Normal daily and seasonal fluctuations above these levels shall be maintained.

4.3 Biochemical Oxygen Demand (Freshwater)

Biochemical Oxygen Demand (B.O.D.) shall not be increased to exceed values which would cause dissolved oxygen to be depressed below the limit established for each class and, in no case, shall it be great enough to produce nuisance conditions.

4.4 Natural Conditions

In addition to the standards for nutrients, D.O. and B.O.D. described above, Florida's standards include provisions that address waterbodies which do not meet the standards due to "natural background" conditions.

"'Natural Background' shall mean the condition of waters in the absence of man-induced alterations based on the best scientific information available to the Department. The establishment of natural background for an altered waterbody may be based upon a similar unaltered waterbody or on historical pre-alteration data." [Section 62-302.200(15) FAC].

Florida standards also state at 62-302.300(15) FAC that "Pollution which causes or contributes to new violations of water quality standards or to continuation of existing violations is harmful to the waters of this State and shall not be allowed. Waters having water quality below the criteria established for them shall be protected and enhanced. However, the Department shall not strive to abate natural conditions."

5. WATER QUALITY ASSESSMENT

To determine the status of surface water quality in Florida, three categories of data – chemistry data, biological data, and fish consumption advisories – were evaluated to determine potential impairments. The level of impairment is defined in the Identification of Impaired Surface Waters Rule (IWR), Section 62-303 of the Florida Administrative Code (F.A.C.). The IWR defines FDEP's threshold for identifying water quality limited WBIDs to be included on the state's 303 (d) list. In addition, all waters on the 1998 303 (d) list that were not de-listed remain on the current 303 (d) list and require TMDLs. The WBID 3211 is on FDEP's planning list for Dissolved Oxygen and Nutrients; EPA assessed this WBID and concluded that it is impaired, and a Dissolved Oxygen and Nutrients TMDL must be developed.

FDEP maintains ambient monitoring stations throughout the basin. All data collected at monitoring stations within the impaired WBID are used in the analysis and shown in Appendix A

6. SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of pollutants in the watershed and the amount of pollutant loading contributed by each of these sources. Sources are broadly classified as either point or non-point sources.

A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted facilities discharging treated sanitary wastewater or stormwater (i.e., Phase I or II MS4 discharges) are considered primary point sources of BOD, nutrients and TSS.

Non-point sources are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation on land surfaces and wash off as a result of storm events. Typical non-point sources of BOD, nutrients and TSS include:

- Wildlife
- Agricultural animals
- Onsite Sewer Treatment and Disposal Systems (septic tanks)
- Urban development (outside of Phase I or II MS4 discharges)

A geographic information system (GIS) tool was used to display, analyze, and compile available information to characterize potential sources in the impaired WBID. This information includes land use, point source dischargers, soil types and characteristics, population data (human and livestock), and stream characteristics.

6.1 Point Sources

In this planning unit, there are 19 permitted wastewater treatment facilities, 11 treating domestic wastewater, and 8 treating industrial wastewater. Only 3 of these facilities discharge to surface water. The Martin County Utilities (MCU) Consolidated Reuse System (South County) in Port Salerno, NPDES FL0043214 is a wastewater reclamation/reuse facility and is only allowed to discharge intermittently during periods of heavy rainfall under its NPDES permit. This is the only permitted wastewater facility discharging to surface water that would impact the waters of WBID 3211. This reuse facility receives treated effluent from several wastewater treatment plants and is permitted to discharge to golf course ponds and land application sites. Only intermittent discharges from these golf course ponds are permitted. The MCU Martin Downs Wastewater Treatment Facility in Palm City, included under the MCU permit, has a design capacity of 2 mgd but does not discharge to surface water. There are 2 closed solid waste landfills in this planning unit. According to FDEP records, in the South St. Lucie planning unit, there are 8 dry cleaning facilities and approximately 90 reported discharges from petroleum facilities. There are no state-funded or federal (National

Priorities List [NPL]) hazardous waste cleanup sites or delineated ground water contamination areas in this planning unit. Figure 3 shows permitted wastewater treatment facilities, landfills, and delineated areas in the South St. Lucie River planning unit.

Municipal Separate Storm Sewer Systems (MS4s) may also discharges to water-bodies in response to storm events. Large, medium, and small MS4s serving populations greater than 50,000 people, or with an overall population density of 1,000 people per square mile, are required to obtain a NPDES storm water permit. There are three MS4 permits in Martin County; Martin County (FLR04E013), City of Stuart (FLR04E031), and Sewall's Point (FLR04E044).

6.2 Non-point Sources

Runoff from urban and agricultural areas impacts water quality in Bessey Creek and its tributaries. Predominant land uses in the South St. Lucie planning unit are agriculture (34 percent) and urban/built-up (26 percent). The primary agricultural land use is improved pasture (25 percent of planning unit). The predominant land use within the urban/built-up category is low-density residential (approximately 10 percent).

6.3 Agricultural Animals

Agricultural animals are the source of nutrient loadings to streams, that impact water quality. This source includes agriculture runoff from pastureland and cattle in streams. The land use within the impaired WBID is only 4 percent agricultural and rangeland (Table 1), so this landuse likely does not discharge a significant amount of the nutrient load.

The USDA National Agricultural Statistics Service (NASS) compiles Census of Agriculture data by county for virtually every facet of U.S. agriculture (USDA, 2002). The "Census of Agriculture Act of 1997" (Title 7, United States Code, Section 2204g) directs the Secretary of Agriculture to conduct a census of agriculture on a 5-year cycle collecting data for the years ending in 2 and 7. Livestock inventory from the 2002 Census of Agriculture reports for Martin County is listed in Table 2. Cattle and calves are the predominate livestock. Confined Animal Feeding Operations (CAFOs) are not known to operate in either St. Lucie or Martin County.

In 2002, NASS reported 221,537 acres of farmland in St. Lucie County and 206,198 acres of farmland in Martin County.

Table 2. Livestock Inventory by County (source: NASS, 2002)

Livestock (inventory)	Martin
Cattle and calves	27,279

Hogs and Pigs	439

6.4 Onsite Sewerage Treatment and Disposal Systems (Septic Tanks)

Onsite sewage treatment and disposal systems (OSTDs) including septic tanks are commonly used where providing central sewer is not cost effective or practical. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTD is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrient (nitrogen and phosphorus), pathogens, and other pollutants to both ground water and surface water. The State of Florida Department of Health (www.doh.state.fl.us/environment/ostds/statistics/ostdsstatistics.htm) publishes septic tanks data on a county basis. Table 3 summarizes the cumulative number of septic systems installed since the 1970 census. The data does not reflect septic tanks removed from service.

Table 3. County Estimates of Septic Tank Installations (FDEP, 2004)

County	Number Septic Tanks (1970-2002)
Martin	27,284

6.5 Urban Development

Nutrient loading from urban areas is attributable to multiple sources including storm-water runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals.

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of non-point source pollution by requiring new development and redevelopment to treat storm-water before it is discharged. The Stormwater Rule, as outlined in Chapter 403 Florida Statutes (F.S.), was established as a technology-based program that relies upon the implementation of BMPs that are designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C. Florida's storm-water program is unique in having a performance standard for older storm-water systems that were built before the implementation of the Stormwater Rule in 1982. This rule states: "the pollutant loading from older storm-water management systems shall be reduced as needed to restore or maintain the beneficial uses of water" (Section 62-4-.432 (5) (c), F.A.C.).

Nonstructural and structural BMPs are an integral part of the State's storm-water programs. Nonstructural BMPs, often referred to as "source controls", are those that can be used to prevent the generation of NPS pollutants or to limit their transport off-site. Typical nonstructural BMPs include public education, land use management, preservation of wetlands and floodplains, and minimizing

impervious surfaces. Technology-based structural BMPs are used to mitigate the increased storm-water peak discharge rate, volume, and pollutant loadings that accompany urbanization.

7. Analytical Approach

The approach for calculating DO and nutrient TMDLs depends on the number of water quality samples and the availability of data. When minimal or no nutrient or BOD and flow data are available, the existing loads are calculated using the nonpoint source spreadsheet and the TMDL is expressed as a percent reduction to meet a pollutant concentration target based on natural conditions. The assumption made is that BOD and nutrients have the major controllable impacts on dissolved oxygen. To return dissolved oxygen to a "naturally" expected condition, not impacted by pollutants, the BOD and nutrient loadings will also need to be returned to natural loading conditions. However since dissolved oxygen is also impacted (lowered) by the instream modifications such as dredging and channelization. These processes slow down the water velocity and reduce reaeration and increase solids settling there by increasing sediment oxygen demand (SOD) and may result in a low DO condition. Therefore, Bessey creek dissolved oxygen may not achieve the designated water quality standards. Further analyses and monitoring will have to be completed to develop an appropriate site specific dissolved oxygen criterion.

Using the landuse distribution the existing and natural Biochemical Oxygen Demand (BOD) loads were calculated based on an average rainfall of 50 inches per year. The 3211 natural values were calculated by assigning the non-water portion of the drainage area half to forest and half to wetlands loading values, see Table 4. For Total Nitrogen (TN), Total Phosphorus (TP) the existing loads were calculated and reduced by 43 percent as required by the St Lucie Estuary TMDL nutrient reductions.

Table 4 WBID 3211 Estimated Existing and Natural TN, TP and BOD Loads

WBID	Total Annual Load (lbs/year)*		
	TN	TP	BOD
3211	3,169	456	12,560
3211 Natural	1,805	260	4,310

*To calculate the total daily load, divide the total annual load by 365.

8. Development of Total Maximum Daily Loads

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), non-point source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

TMDL = Σ WLAs + Σ LAs + MOS

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measures. TMDLs for the Bessey Creek WBID is expressed as a concentration.

8.1 Critical Conditions

Critical conditions are accounted for in the analyses by using annual loads and all water quality information and data available for the WBID.

8.2 Margin of Safety

TMDLs shall include a margin of safety that takes into account any lack of knowledge about the pollutant loading and in-stream water quality. In this case the measured water quality was used directly to determine the reduction to meet the water quality standard. In this case the lack of knowledge concerns the data, and how well it represents the true water quality. There are two methods for incorporating a MOS in the analysis: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. In the Wagner Creek WBID 3288A TMDL, an implicit MOS was used by targeting a background loading based on natural landuses

8.3 Determination of TMDL, LA and WLA

The TMDL values represent the maximum daily load the stream can assimilate and maintain water quality standards. TMDL components for the impaired water-bodies required to achieve the numerical criterion are summarized in Table 5.

Table 5. Summary of TMDL Components

Stream Name / WBID	Parameter	WLA	LA	TMDL
		MS4		
Bessey Creek (3211)	BOD	66% reduction	66% reduction	66% reduction
Bessey Creek (3211)	TN	43% reduction	43% reduction	43% reduction
Bessey Creek (3211)	TP	43% reduction	43% reduction	43% reduction

8.4 Seasonal Variation

Seasonal variation was not evaluated because the only available water quality analyses associated

with the impaired WBIDs was calculated based on annual loads

8.5 Recommendations

Basin Management Action Plan:

Following the adoption of this TMDL by rule, the next step in the TMDL process is to develop an implementation plan for the TMDL, referred to as the BMAP. This document will be developed over the next year in cooperation with local stakeholders and will attempt to reach consensus on more detailed allocations and on how load reductions will be accomplished. The BMAP will include the following:

- Appropriate allocations among the affected parties,
- A description of the load reduction activities to be undertaken,
- Timetables for project implementation and completion,
- Funding mechanisms that may be utilized,
- Any applicable signed agreement,
- Local ordinances defining actions to be taken or prohibited,
- Local water quality standards, permits, or load limitation agreements, and
- Monitoring and follow-up measures.
-

As this TMDL is implemented, the Agency strongly encourages the development of site-specific dissolved oxygen and nutrient criteria for Bessey Creek.

9. REFERENCES

Cleland, Bruce, 2003. *TMDL development from the "bottom up" – Part III: Duration curves and wet-weather assessments.* America's Clean Water Foundation, Washington, DC. September 15, 2003.

Florida Administrative Code (F.A.C.). Chapter 62-302, Surface Water Quality Standards.

Florida Department of Environmental Protection (FDEP), 2003. *Basin Status Report, St. Lucie and Loxahatchee Basin,* FDEP Division of Water Resource Management, Group 2 Basin, February 2003.

P.R. Hunter. 2002. The Society for Applied Microbiology, Letters in Applied Microbiology. 34. 283–286.

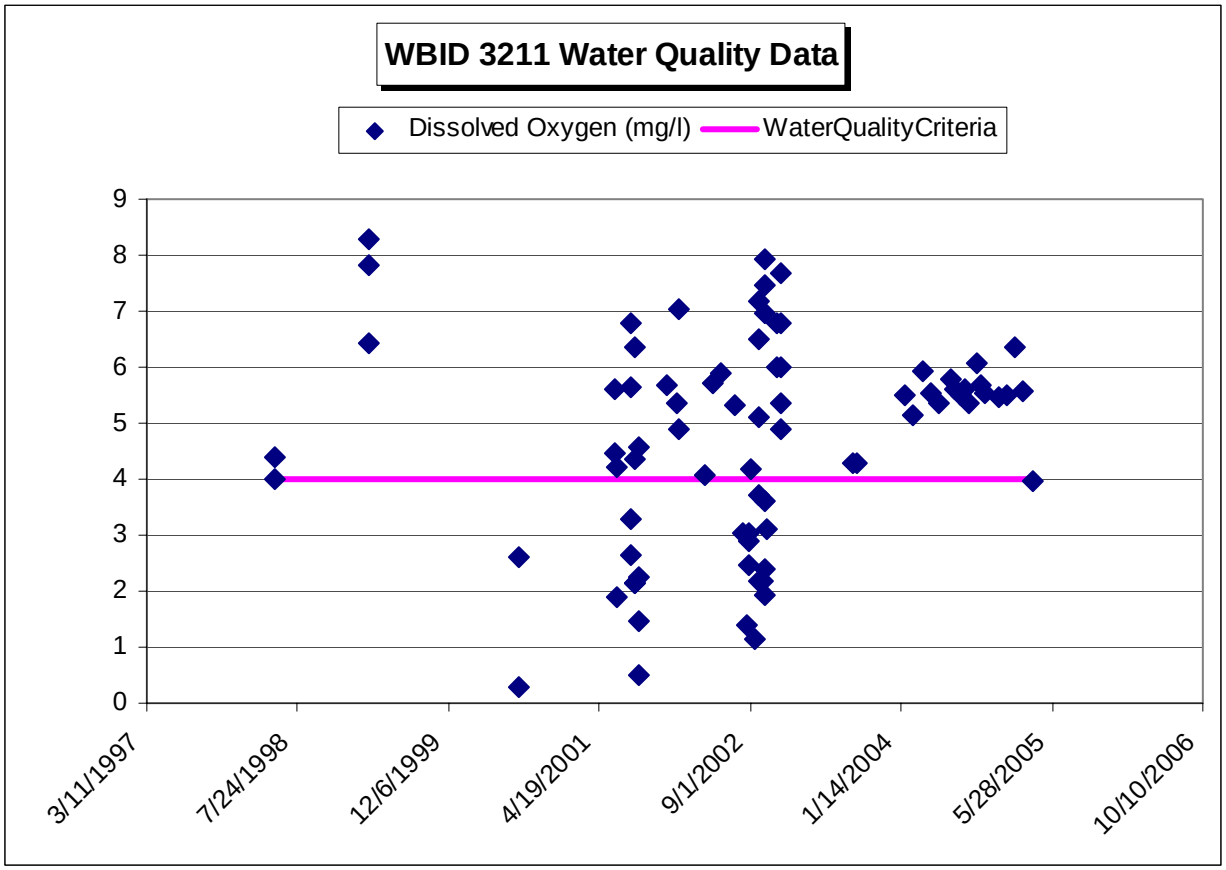
USDA, 1997. *1997 Census of Agriculture, Volume 1, Geographic Area Series, Part 42,* U.S. Department of Agriculture, National Agricultural Statistics Service. AC97-A-42, March 1999.

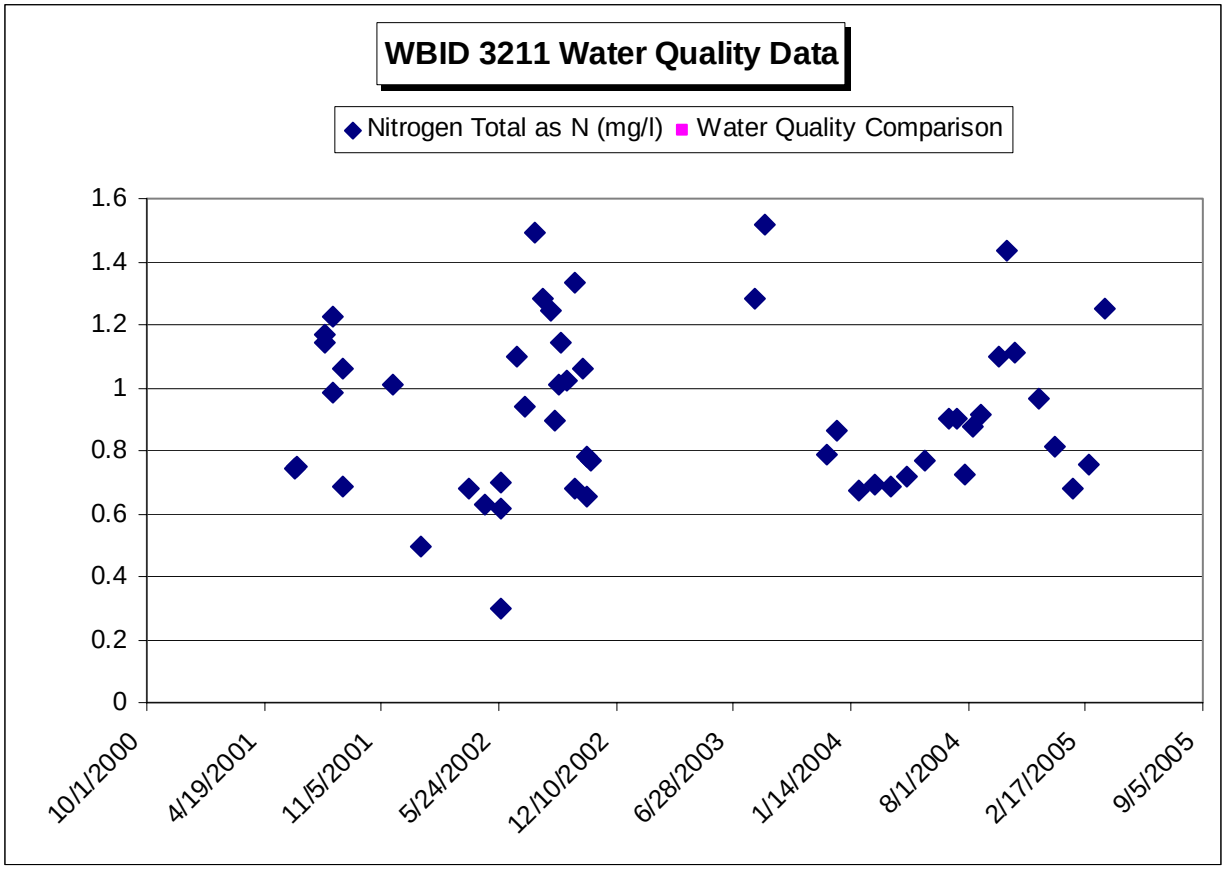
USDA, 1997. *2002 Census of Agriculture, Volume 1, Geographic Area Series, Part 9,* U.S. Department of Agriculture, National Agricultural Statistics Service. AC02-A-9, June 2004.

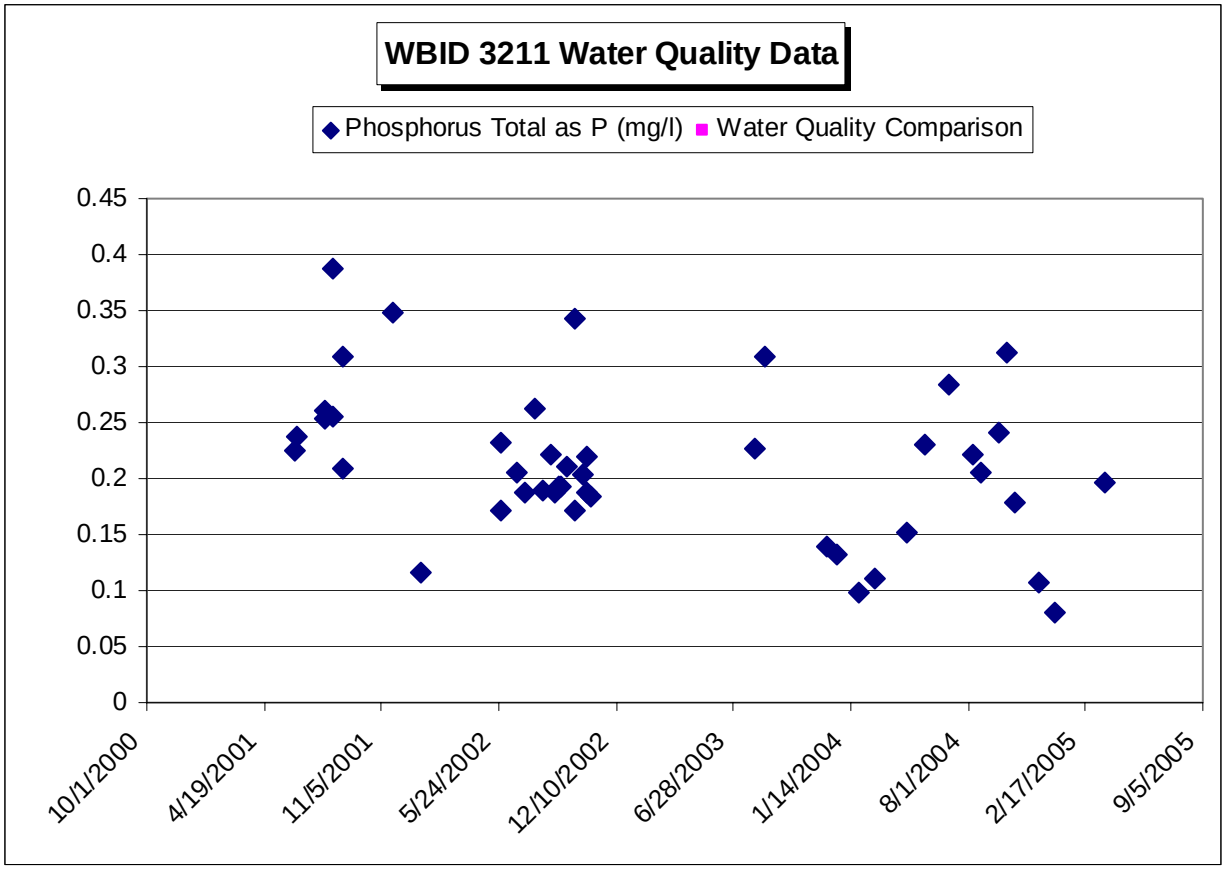
USEPA, 1991. *Guidance for Water Quality –based Decisions: The TMDL Process.* U.S. Environmental Protection Agency, Office of Water, Washington, DC. EPA-440/4-91-001, April 1991.

Southwest Florida Management District. *Peace River Cumulative Impact Assessment*. http://www.swfwmd.state.fl.us/waterman/peaceriver.

APPENDIX A: Water Quality Data




WBID 3211 Water Quality Data
Nitrogen Total as N (mg/l)
Water Quality Comparison
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
10/1/2000
4/19/2001
11/5/2001
5/24/2002
12/10/2002
6/28/2003
1/14/2004
8/1/2004
2/17/2005
9/5/2005


WBID 3211 Water Quality Data
Phosphorus Total as P (mg/l)
Water Quality Comparison
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10/1/2000
4/19/2001
11/5/2001
5/24/2002
12/10/2002
6/28/2003
1/14/2004
8/1/2004
2/17/2005
9/5/2005